XVI.—*On the Fatty Matters of Human Excrements in Disease.*

By W. Marcet, M.D., F.C.S.,

ASSISTANT PHYSICIAN TO THE WESTMINSTER HOSPITAL, ETC., ETC.

It has often been noticed that excessive quantities of fats are voided by the motions in certain diseases; but no attempt having been made to separate these fatty substances from each other, and obtain them in the form of Immediate Principles, I have undertaken this task in one case, by adopting a method of investigation similar to that which I had made use of for the analysis of healthy excrements. The case in question is that of a man who was for a long time my patient at the Westminster Hospital, labouring, apparently, under disease of the kidneys. From his excessive emaciation, it was evident that the assimilation was very defective, and, with the view of endeavouring to obtain some further insight into the nature of the disease, his fæces were submitted to examination. They had the consistence of putty, a yellow grey colour, and a strongly acid reaction. When boiled with alcohol, they formed an homogeneous mass, which, being squeezed in a muslin bag, yielded a turbid alcoholic fluid; this was now filtered through filtering paper, and the insoluble residue exhausted with boiling alcohol. On cooling, an abundant crystalline deposit, quite free from colouring matter, occurred in the solution. In order to analyse the deposit, it was collected on a filter, and the filtrate was left to evaporate spontaneously. I removed the deposit to a flask, and then treated it with ether, until nothing more was dissolved; by so doing, the crystalline mass was divided into a substance insoluble in ether, and one which was soluble in this fluid. The substance insoluble in ether dissolved in hot alcohol, but was sparingly soluble in cold alcohol; the solution had an acid reaction. The crystals were soluble in hot water; but the addition of cold water to the alcoholic solution, induced the formation of a cloudy precipitate, and the fluid gradually became neutral.

This compound fused at a temperature ranging between 100° and 103° C. When the aqueous solution was mixed with hydrochloric acid, the liquid deposited white flakes; these were collected on a filter, and the acid filtrate being evaporated to dryness, left a residue, which did not clear on the application of a strong heat, and was found to consist of nothing but

chloride of sodium. The white precipitate being washed with water till the washings ceased to give a precipitate in a solution of nitrate of silver, was treated with ether, when it dissolved, resuming its crystalline form by spontaneous evaporation; the crystals were also soluble in hot alcohol. They fused at 66° C. and reappeared at 64° C. When burnt on a platinum spatula, this substance charred, ignited, and left no residue.

In short, there could be no doubt but that it was stearic acid; consequently, it appeared very probable that the original compound insoluble in ether was the *bistearate* or the *stearate of soda*. The fact was placed beyond doubt by a quantitative analysis of the substance. For this purpose, a sample of the compound, thoroughly exhausted with ether, was dried over sulphuric acid, under the air-pump, until it ceased to lose weight; it was then found to weigh 0·275 grammes. The substance was now dissolved in hot water, (being insoluble in cold water) and decomposed with hydrochloric acid in excess, when an abundant flocculent precipitate of fatty acid occurred. The precipitate collected on a filter, and washed with distilled water (till the washing ceased to produce a haziness in a solution of nitrate of silver), was removed into a weighed watch-glass, to be dried over sulphuric acid under the air-pump. In order to avoid losing a trace of the fatty acid, the filter itself was treated with ether, and the solution evaporated to dryness in a weighed watch-glass, which, when dried under the air-pump, gave only 0·006 grammes of the substance. The whole weight of the perfectly dry fatty acid was 0·259; therefore, 0·275 grammes of the compound submitted to analysis, consisted of

0·259 grammes of stearic acid,
and 0·016 grammes of soda.

0·275

or, 100 parts contained

94·18 of stearic acid,
and 5·82 of soda.

100·00

Chevreul found 100 parts of bistearate of soda to consist of

Stearic acid . . .	94·33
Soda	5·67
	100·00

Consequently, the substance under examination was *bistearate of soda.*

It is the first time, I believe, that *bistearate of soda* has been extracted directly from the animal body, and, consequently, in the form of an Immediate Principle. Its separation from the other fatty acids is very easy, on account of the circumstance that this compound is insoluble in ether; and it is readily distinguished from the other soaps by its property of crystallising in a concentrated alcoholic solution as soon as the fluid has become cold, whilst the other compounds of fatty acid and soda solidify from their solution in alcohol, in the form of a gelatinous deposit, which crystallises on standing, after some time has elapsed. Bistearate of soda was first obtained by Chevreul by dissolving 1 part of stearate of soda in 2000 or 3000 parts of hot water, filtering the liquor when cold, washing the deposit, drying it and treating it with hot alcohol; the solution, when cold, deposited *bistearate of soda.**

In no case have I detected this compound as an Immediate Principle of healthy human evacuations; it is, consequently, a morbid product, resulting, in all probability, from the action of abnormally large quantities of free acids in the intestinal canal: the very acid reaction of the excrements supports this view. Healthy human fæces yield margarate of lime and margarate of magnesia; if they contain any soda or potash soap at all, it must be in very small quantities. Free fatty acids do not exist in healthy human evacuations, unless a comparatively large amount of vegetable food has been taken; and in these cases I have not detected the presence of any bistearate.

The excrements in the present instance yielded not only bistearate of soda, but a considerable quantity of free fatty acids, which most probably depended, as I shall presently show, on the functions of the pancreas and liver being arrested.

The alcoholic filtrate from the bistearate of soda, gave on standing, another crop of crystals, consisting of a mixture of bistearate of soda and of fatty acid. By treating these various deposits with ether, a substance was dissolved which crystallised by spontaneous evaporation, and proved to be a mixture of stearic and margaric acids, the former being in excess. The crystallised deposit possessed the following characters. The crystals occurred under the form of small white masses, exhibiting under the microscope groups

* Recherches Chimiques sur les corps gras d'origine animale. Par M. L. Chevreul.

of needles radiating from the centre to the periphery. They fused at a temperature of 60°C, which, according to Gottlieb, corresponds to a mixture of eighteen parts of stearic with ten parts of margaric acid; they were soluble in cold ether and in hot alcohol, and insoluble in water; the substance dissolved in potash and could be precipitated in this alkaline liquor by means of hydrochloric acid; when heated on the platina-knife, the crystals fused, ignited, and finally left no residue. These characters are precisely those of the above-mentioned fatty acids; the amount of the mixture at my disposal did not allow of the complete separation of these acids being effected.

The clear alcoholic fluid being allowed to stand undisturbed for twenty-four hours, yielded another crop of beautifully white glistening crystals. These were submitted to examination and proved to be *margaric acid,* apparently free from stearic acid. These crystals dissolved in ether and hot alcohol, and crystallised from these solutions; the ethereal and alcoholic fluids had an acid reaction; the substance was insoluble in water, but dissolved in aqua potassæ. Hydrochloric acid induced its precipitation from the alkaline liquor. It fused at 53° Cent., and crystallised, on cooling, at 49°, this low fusing point being due probably to the admixture of a small quantity of oleic acid; the crystals occurred in the form of small radiating masses peculiar to margaric acid; they burnt with a fuliginous flame, leaving no trace of ashes.

The occurrence of such quantities of fatty acids in this case being considered in connection with the condition of the body of the patient, is of great interest, not only in a chemical but also in a physiological and pathological point of view. The pancreas of the patient was found, at a *post mortem* examination, entirely disorganised by malignant disease, and it apparently so compressed the duct of the gall bladder that no bile could flow into the intestines. Consequently, the two alkaline intestinal secretions were wanting, and the fatty acids contained in the alimentary canal could not be neutralised. This is an important fact in favour of Bernard's view respecting the properties of the pancreatic juice.

I avail myself with pleasure of this opportunity to acknowledge the valuable aid I have received from my assistant, Dr. Frederick Dupré in these and other investigations.